



(12) **United States Patent**
Scoville et al.

(10) **Patent No.:** **US 9,993,580 B2**
(45) **Date of Patent:** **Jun. 12, 2018**

(54) **PRODUCTS COMPRISING AN
EXTRACELLULAR MATRIX TISSUE
MATERIAL AND OSTEOGENIC PROTEIN**

(71) Applicant: **Muffin Incorporated**, West Lafayette,
IN (US)

(72) Inventors: **Shelley Lynn Scoville**, Athens, GA
(US); **Amanda F. Taylor**, West
Lafayette, IN (US); **Steven Charlebois**,
West Lafayette, IN (US); **Christine M.
Steinhart**, Ramona, CA (US); **Neal E.
Fearnot**, West Lafayette, IN (US)

(73) Assignee: **Muffin Incorporated**, West Lafayette,
IN (US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

(21) Appl. No.: **15/058,329**

(22) Filed: **Mar. 2, 2016**

(65) **Prior Publication Data**
US 2016/0263282 A1 Sep. 15, 2016

Related U.S. Application Data

(63) Continuation of application No.
PCT/US2014/053671, filed on Sep. 2, 2014.

(60) Provisional application No. 61/872,827, filed on Sep.
2, 2013.

(51) **Int. Cl.**
C07K 9/00 (2006.01)
A61L 27/36 (2006.01)
A61L 27/54 (2006.01)
A61L 27/12 (2006.01)

(52) **U.S. Cl.**
CPC **A61L 27/3633** (2013.01); **A61L 27/12**
(2013.01); **A61L 27/54** (2013.01); **A61L**
2300/414 (2013.01); **A61L 2400/06** (2013.01);
A61L 2430/02 (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,180,606	B1	1/2001	Chen et al.
6,206,957	B1	3/2001	Driessens et al.
8,435,552	B2	5/2013	O'Brien et al.
2007/0191963	A1	8/2007	Winterbottom et al.
2008/0274184	A1	11/2008	Hunt
2011/0230406	A1*	9/2011	Kehoe A61K 47/48292 514/8.8

FOREIGN PATENT DOCUMENTS

EP	1 312 383	5/2003
WO	WO 2005/097219	A2 10/2005
WO	WO 2009/114535	A2 9/2009
WO	WO 2015/031809	A1 3/2015

OTHER PUBLICATIONS

Ruppert Hugh-Fulford Journal of Orthopedic Surgery and Research,
2011, 6:8.*
Voytik-Harbin Tissue Engineering, vol. 4, No. 2, 1998.*
International Search Report and Written Opinion issued in PCT/
US2014/053671, dated Dec. 11, 2014, 17 pgs.
Lutolf, M. P. et al., "Repair of Bone Defects Using Synthetic
Mimetics of Collagenous Extracellular Matrices," Nature Biotech-
nology, 2003, vol. 21, pp. 513-518.
Ruppert, R., et al., "Human Bone Morphogenetic Protein 2 Contains
a Heparin-Binding Site which Modifies its Biological Activity,"
European Journal of Biochemistry, 1996, vol. 237, pp. 295-302.
Vejlens, Lars, "Glycosaminoglycans of Human Bone Tissue," Calc
Tiss, Res. 7 (1971), pp. 175-190.

* cited by examiner

Primary Examiner — Jeanette M Lieb
(74) *Attorney, Agent, or Firm* — Woodard, Emhardt,
Moriarty, McNett & Henry LLP

(57) **ABSTRACT**

Osteogenic compositions include a decellularized extracel-
lular matrix tissue and bone morphogenic protein, preferably
BMP-2. The compositions make beneficial use of the BMP,
which can be used at relatively low doses and can bind to
native components (e.g., native sulfated glycosaminogly-
cans such as heparin and/or heparan sulfate) remaining in
the decellularized extracellular matrix tissue. Methods for
preparation and use of such compositions are also described.
The compositions and related methods can be used in the
treatment of diseased or damaged bone tissue.

22 Claims, 1 Drawing Sheet